Analysis of Onion Management Practices as they relate to levels of *Aspergillus niger* (Black Mold) and Development of IPM scouting protocols for Black mold

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Abstract:

Black mold (*Asperigillus niger*) has increasingly been a problem for Orange county onion growers. In 1999 we intended to see if the procedure of rolling early season onions with green tops, prior to harvest, was creating wounds and openings through which wind blown and/or soil borne inoculum of black mold was infecting the outer scales of onion bulbs. Black mold favors high temperatures. Temperatures generally are quite warm during late July and early August when rolling usually occurs. We also looked at undercutting, lifting and windrowing. We thought these practices might reduce black mold by drying the onions without making wounds.

The summer of 1999 was very dry. For most of the Orange county onion-growing region, rainfall was well below average or practically non-existent. The entire onion crop went down early. This situation did not allow for growers to roll their onions. We were able to compare undercutting, lifting and windrowing and found surprising results. Results showed increased black mold incidence when onions were undercut, lifted or windrowed.

In 2000, we repeated the investigation to see if we would get similar results. Prof. James Lorbeer tested *Aspergillus niger* levels in the soil from the fields involved in the investigation. Soil samples taken this year correlate the highest inoculum levels with fields that have had the least rotation out of onions. The field with the highest soil inoculum rating was also the only field that showed onions with a detectable % of BM before and after storage. The 2000 season was cool and wet; overall incidence of black mold in onion bulbs was low probably due to weather conditions. Because of this it is difficult to draw conclusions based on the data collected this year. Data collected over the past three years on % black mold by variety can help researchers narrow down control options and perhaps guide growers to less susceptible varieties. In the past two years, four scouts have been trained to identify *Aspergillus niger* in the field. Historically, we have not been able to detect black mold in the field until bulbs are very close to maturity. It therefore stands to reason that scouting for black mold just prior to harvest is most practical. This information will help growers make better harvest and storage management decisions.

Background and Justification:

It is still not completely understood how and when *Aspergillus niger* (Black mold) infects onion bulbs. Three things are needed to have a disease outbreak. First, a suitable host is needed. Second, the pathogen must be present and thirdly, conditions favoring the pathogen must also be present. When all three of these factors come together a major outbreak of the disease will occur.

During the summer of 1995, there were high temperatures and moist/wet conditions from mid July through harvest. A major outbreak of black mold occurred that year and there have been smaller but no less insignificant outbreaks since. Some growers have continued to have problems while other growers

have had little or no black mold problems since 1995. Research by Prof. James Lorbeer has shown significant levels of *A. niger* present in soil and onion seeds. It is still not fully understood what the impact *A. niger* seed infection has on late season disease levels but these findings show plenty of *A. niger* inoculum is present throughout the growing season.

To accelerate leaf drying, a common practice for onions growers is to roll the tops of early season onion plants with green leaves. This is done to hasten harvest to coincide with a favorable marketing niche. This process does not allow for complete drying of the tissues of onion necks. This succulent neck tissue, when wounded, is susceptible to infection by a number of opportunistic onion pathogens. If the right weather conditions are present at the time of rolling, it is possible this cultural practice is unwittingly helping to stimulate black mold disease levels.

Lifting of onions with a rotating bar, undercutting (severing all roots with a blade), and windrowing onions serve to dry onions down prior to harvest. Dryer onions could mean less infection by *A. niger*. In the past, not many Orange County growers employed lifting, undercutting or windrowing on a regular basis. Within the last few years, some Orange County growers have been building and using newer equipment. This study tried to evaluate the effectiveness of this equipment and drying techniques on black mold occurrences.

Currently, there are no IPM scouting protocols for black mold. Usually, it is only possible to detect black mold very late in the season or in storage. Maggot and smut damage is scouted early in the season and scouting data gives growers a clear idea on the level of infestations. With black mold, some growers have higher levels than other growers. Working with cooperating growers, fields having historically high levels of black mold were closely monitored throughout the season. Black mold evaluations were carried out during the season to see if we could visually detect black mold on onions early. If successful, this information would enable growers to keep levels down by modifying their spray intervals or by employing cultural practices that increase onion dry-down in the field and in storage.

The strength of the field research by the Orange county IPM program is the fact scouts are collecting data in actual grower fields every day throughout the growing season. Scouts are able to evaluate actual grower practice and conditions in production fields and collect valuable data that cannot be obtained any other way.

Objectives:

1- To determine if in field onion drying practices (lifting, undercutting and/or windrowing) impact the occurrence of black mold in onions.

2- To see if any correlation can be made between levels of black mold in the soil (Prof. Lorbeer) and occurrence of infection in onion bulbs.

3- To evaluate selected early, midseason and late season varieties for resistance to black mold infection

4- To develop IPM scouting procedures for the in-field detection of black mold and to correlate in-field black mold levels to storage levels.

Procedures and Results:

1 - Three growers participated in this investigation. A total of seven onion fields were sampled. Each field consisted of two side-by-side plots with the same variety and planting date. The varieties sampled included: New York Early, Uniglobe, Sabroso, Barrage and Duration. In each field, the grower either lifted, undercut or windrowed prior to harvest. In all but one field (Uniglobe), growers left a 30-foot

length of onion bed that **was not** lifted, windrowed or undercut. Two sets of onion samples (one from each treatment) (50 onions /treatment) evaluated for Black Mold in the field, placed in net bags, labeled, brought to Ithaca and placed in Prof. Lorbeer's storage unit. These onions were then removed from storage in early December and evaluated again for black mold levels. (See table1)

Black Mold levels overall were very low for the 2000 growing season. Because of this it is difficult to discern whether the windrowing, undercutting or lifting practices have any impact on Black Mold incidence. The lifting practice does seem to have a positive impact on bacterial incidence for the varieties Sabroso and Duration -Grower 2. (See table1)

2- In each of the seven fields soil samples were collected from the same areas that onion samples were collected. Sample areas were approximately 30 feet long by 10feet wide and consisted of one lifted bed and one not lifted bed. The IPM coordinator assisted in identifying these areas and collection of the samples.

According to Professor Lobber's soil rankings (table2). The NYE field had the highest level of *Aspergilllus Niger* (Black Mold) present in the soil sample. This is interesting as this was the only field in which Black Mold was observed on the onion bulb both in the field prior to harvest and also after storage.

3-In 2000, the five varieties collected for storage (see procedure#1) were evaluated for incidence and severity of black mold just prior to harvest. Just prior to harvest, the IPM coordinator sampled an additional 13 onion varieties including Criterion, Benchmark, Asgrow 77015, Asgrow 77008, Mira, Fortress, Spectrum, Millennium, Peto 108,Santana, Crusader, Redwing, and Mars. A minimum of 100 onions per variety were sampled. In 1999, just prior to harvest, 13 varieties total were evaluated for Black mold incidence and severity. These included New York Early, Iowa 44, Duration, Sabroso, Barrage, Millennium, Benchmark, Tribute, Redwing, Fortress, Tribute, Asgrow 1540, Hamlet, and Crusader. Only Barrage, NYE, Sabroso, Duration, Iowa 44 were sampled after storage.

In 2000, black mold was detected on one variety, NYE, out of a total of 18 varieties sampled. Weather conditions were wet and cool, not conducive to development of this disease.

In 1999, a total of 13 varieties were sampled for black mold. 1999 was a dry season with favorable conditions for *Aspergillus* development. (See table 4 for %BM/variety) Data from 1998 is also included in this table.

1999 Results/Table 1

Grower	Variety	Infield BM% Infection	Treatment	Storage BM% Infection
1	Barrage	40	Nothing	48
1	Barrage	40	Undercut	62
1	NY Early	18	Nothing	48
1	NY Early	18	Undercut	69

2	NY Early	3	Nothing	17
2	NY Early	3	Lifted	11
2	Sabroso	10	Nothing	35
2	Sabroso	10	Lifted	73
3	Duration	10	Nothing	9
3	Duration	10	Undercut	7
3	NY Early	12	Nothing	39
3	NY Early	12	Undercut	50
4	Barrage	8	Windrow	61
4	Iowa 44	11	Nothing	29
4	Iowa 44	11	Windrow	35

2000 Results/Table 2

Grower	Variety	Infield % Infection	Treatment	Storage % Infection BM/ Bacterial/Dirty Skin/*penn*.	Colony Forming Units of *A. Niger*/gram dry soil*
1	NY Early	0	Nothing	0/13/8/-	3.9x103
1	NY Early	6	Undercut	2/15/6/-	3.9x103
1	Uniglobe	0	Nothing	0/ 4/ 0/-	1.0x103
2	Duration W	0	Lifted	2/2/2/high	0.6x103
2	Duration W	0	Nothing	0/12/9/high	0.6x103
2	Sabroso	0	Lifted	0/6/4/moderate	0.3x103
2	Sabroso	0	Nothing	0/10/4	0.3x103
2	Criterion	0	Lifted	0/2/2/-	0.3x103
2	Criterion	0	Nothing	0/2/0/-	0.3x103
2	Duration 4	0	Lifted	0/2/0/-	0.0x103
2	Duration 4	0	Nothing	0/2/0/-	0.0x103
3	Barrage	0	Nothing	0/0/0/-	2.8x103
3	Barrage	0	Windrow	0/0/18/-	2.8x103

*this data provided by Prof. Lorbeer

1999/98 Black Mold ratings/ table 3

Variety	%BM 99	%BM 98	Variety	%BM 99	%BM 98
Hamlet	22	n/a	Millennium	3	n/a
Sabroso	12	n/a	Fortress	3	0
Duration	13	8/0/0*	Benchmark	3	0
Tribute	9	13	Crusader	2	0
Red wing	9	0	Iowa 44	11	n/a
1540	10	n/a	Barrage	40/8*	n/a
Criterion	n/a	2	NYE	18/12/3*	n/a

***these are % calculated on differing fields /different farms**

4-. Fields were evaluated for black mold three times during the season, twice while growing and then just before harvest. Weekly scouting counts were made for thrips, botrytis leaf blight levels, bacterial soft rot and any other potential problem that may have impacted black mold levels. One hundred onions were inspected for black mold from each field at each evaluation. Scouts were trained to identify Black Mold on Onions for the 2000 season. Because there was very low incidence of the disease this year, it is uncertain at this point, how accurately scouts can assess levels of Black Mold when and if it does occur. Past experience tells us that scouting for this disease is not practical until the onions are close to maturity. A better understanding of which factors contribute to Black Mold incidence, i.e. high soil inoculum levels (why some fields higher than others?), susceptible varieties, conducive weather, will help us pinpoint which fields are at most risk.

Conclusion:

More data needs to be collected to determine if windrowing, lifting, undercutting, or rolling impacts Black Mold incidence. It is doubtful that growers will stop these practices since they are beneficial in reducing pathogen infections overall and they also expedite the harvesting process. It is probably worthwhile to collect at least one more year of data.

Black Mold infection in onions is very weather dependant. Because growers cannot predict weather conditions for the upcoming season, they/we must assume that they need to protect their crop or plant resistant varieties when possible.

We have field data for some of the varieties that are more susceptible to black mold infection, more in-depth research on control options, both chemical and cultural needs to be conducted. More information on varietal susceptibility needs to be acquired.

Preliminary soil sample data suggests that growers who rotate out of onions have lower soil inoculum levels. Although we know that rotation is generally beneficial in reducing pests, more soil sampling, with a broader scope of fields/rotations/growers needs to be conducted before recommendations are made regarding this particular disease.

The need to scout for Black Mold can almost be predicted by the weather and the onion variety. It appears that scouting for black mold should occur late in the season; however, timing of chemical controls (if there are any) is left to question.